11th ICFA International Mini-Workshop on Diagnostics for High-Intensity Hadron Machines

Project Update

Norbert Holtkamp

Accelerator Systems Division

October 21, 2002

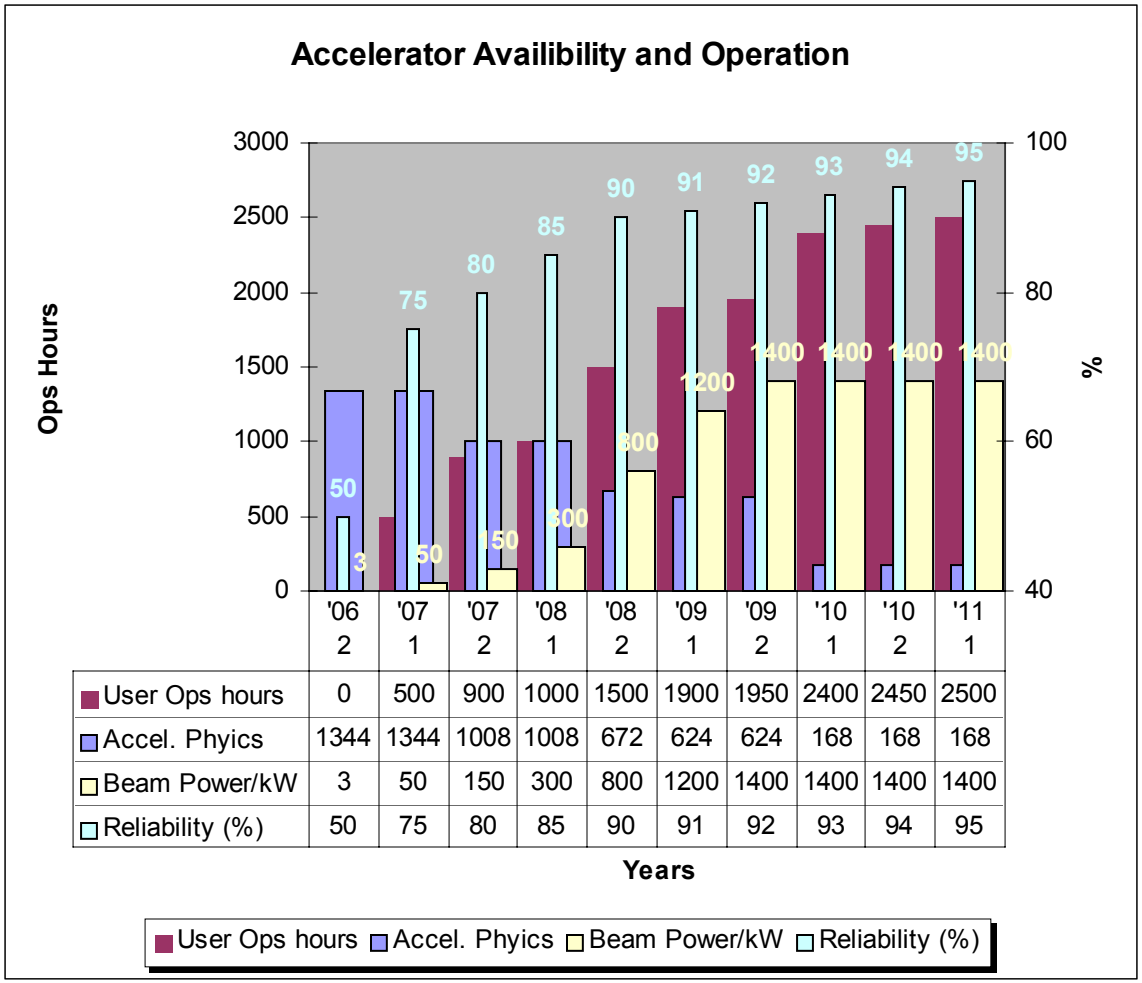
The Spallation Neutron Source

- The SNS will begin operation in 2006
- At 1.4 MW it will be ~8x ISIS, the world's leading pulsed spallation source
- The peak thermal neutron flux will be ~50-100x ILL
- SNS will be the world's leading facility for neutron scattering
- It will be a short drive from HFIR, a reactor source with a flux comparable to the ILL

SNS - Guiding Principles

- SNS will provide high availability, high reliability operation of the world's most powerful pulsed neutron source (cf white paper)
- It will operate as a User Facility to support peer reviewed research on a Best-in-Class suite of instruments
  - Research conducted at SNS will be at the forefront of biology, chemistry, condensed matter physics, materials science and engineering
- SNS will have the capability to advance the state of the art in spallation neutron source technology. This includes:
  - R&D in accelerators, target, and instruments to keep SNS at the forefront
  - Planned enhancement of SNS performance through upgrades of the complex and ongoing instrument development as part of the normal operating life of the facility

Timeline for Operations



Cost Baseline

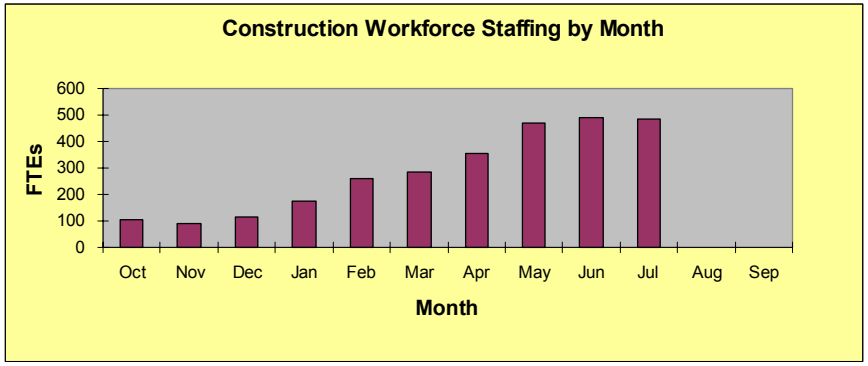
WBS	Description	May Baseline, $M		August Baseline* $M	
1.2	Project Support	75.7		75.7	
1.3	Front End Systems	21.0		21.1	
1.4	Linac Systems	292.1		293.9	
1.5	Ring & Transfer Systems	150.9		151.2	
1.6	Target Systems	101.9		103.2	
1.7	Instrument Systems	63.4		63.3	
1.8	Conventional Facilities	323.6		343.9	
1.9	Integrated Control Systems	59.5		59.6	
	BAC	1,088.1		1,111.9	
	Contingency	104.6	21.0%	80.8	21.0%
	TEC	1,192.7		1,192.7	
	R&D	101.2		101.2	
	Pre-Operations	117.8		117.8	
	TPC	1,411.7		1,411.7	

*Rev. 349.

**Reflects 5% reservation for commitments and awards.

Additional potential PCRs totaling ~$7 M.

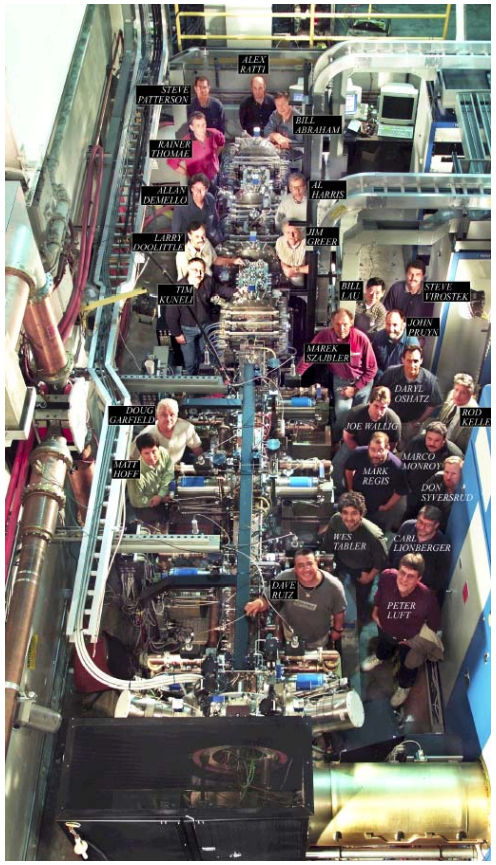
SNS Construction



>1.3M safe hours!

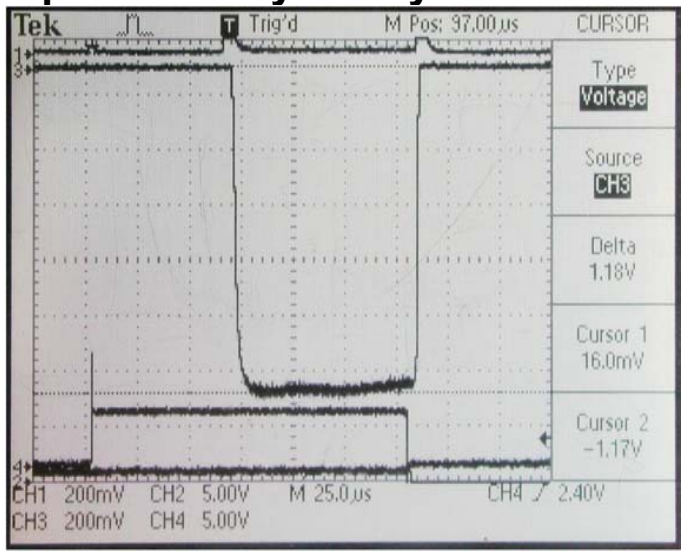
SNS Construction

LBNL Highlights



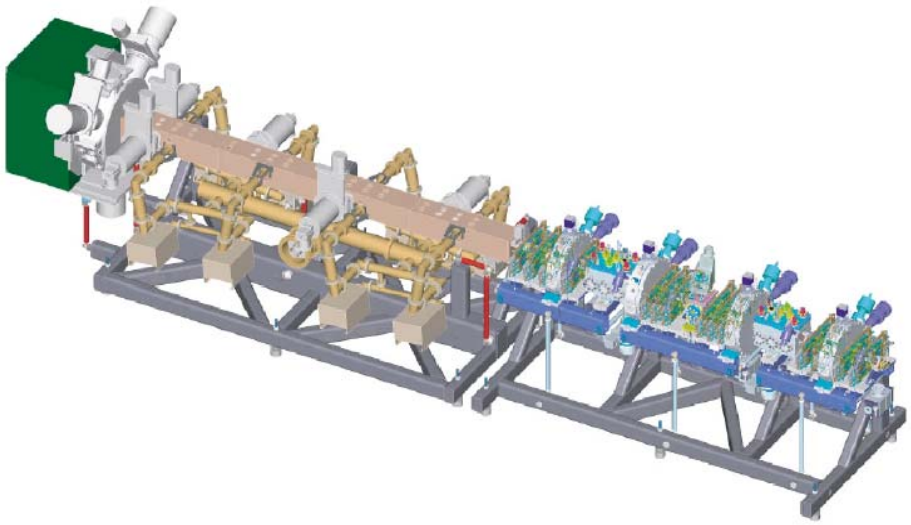
- **All baseline MEBT-subsystems commissioned, (except choppers)**
- **Substantial participation of Partner Labs staff**
- **All major nominal Front-End beam parameters achieved**
- **Front End delivered to SNS-ORNL on schedule, by July 15**

- **Ion-Source and LEBT demonstrated high reliability**
  - Supported 2 months of MEBT commissioning with one single antenna
- **RFQ transmission well above 80% assumed in design**
- **Front-End beam current exceeds requirement by nearly 30%**



50-mA beam current signal at end of MEBT

FES System Installation on the Site



- Front end installed on the site
- Electrical checks are ongoing
- Vacuum checks are ongoing
- Klystron, transmitter and waveguides are installed

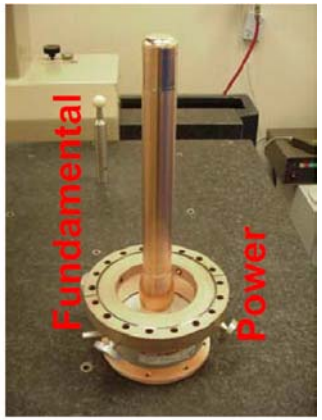
- Begin FES recommissioning October 29, 2002
- Requires RF System availability by October 15

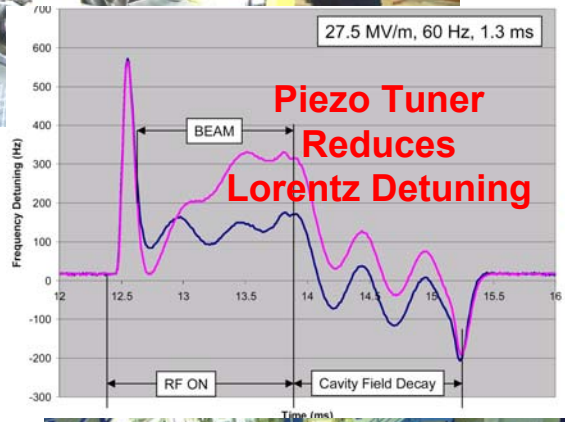
LANL: RFQ & DTL High-Power RF Equipment are Being Accepted, Delivered & Installed

- Marconi now producing 2.5-MW, 402.5-MHz klystrons. They are doing well. Nr. 5 acceptance tested.
- RFQ/DTL/CCL/MEBT klystron transmitter production nearly complete. All warm ones at ORNL.
- Converter modulator substations, SCR controllers, control racks being delivered
- Attention being given to:
  - Converter Modulator HV assembly production schedule
  - LLRF System

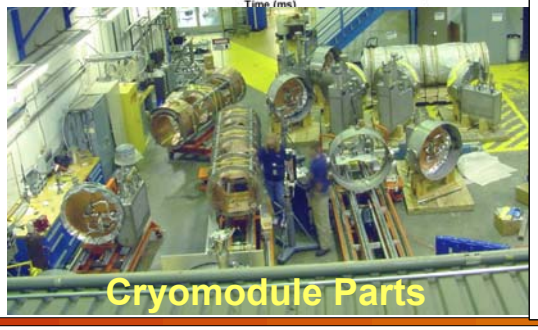
First klystrons, transmitters, circulators, loads, waveguide installed at SNS site

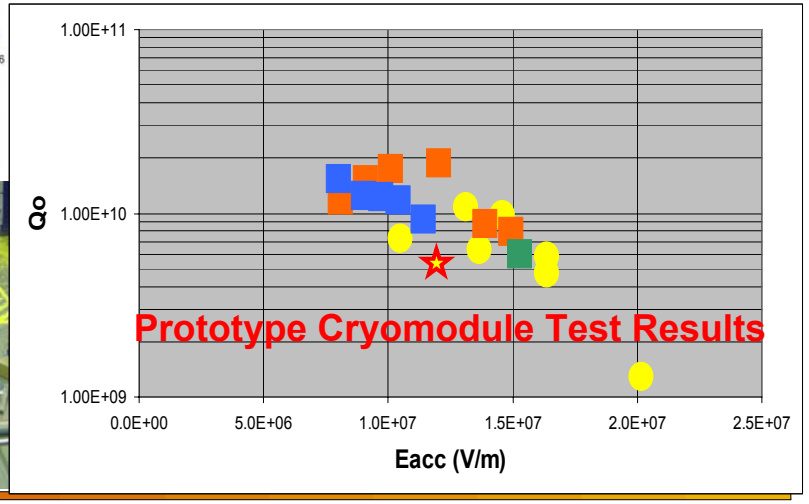
JLab Highlights





- Three pair tested at LANL (up to 2MW peak)
- All have run above full average power (500 kW, 1.3 ms, 60 Hz)
- A 600ºC cavity bake out has been shown to provide acceptable protection against Q-disease





Cryo Installation on the Site

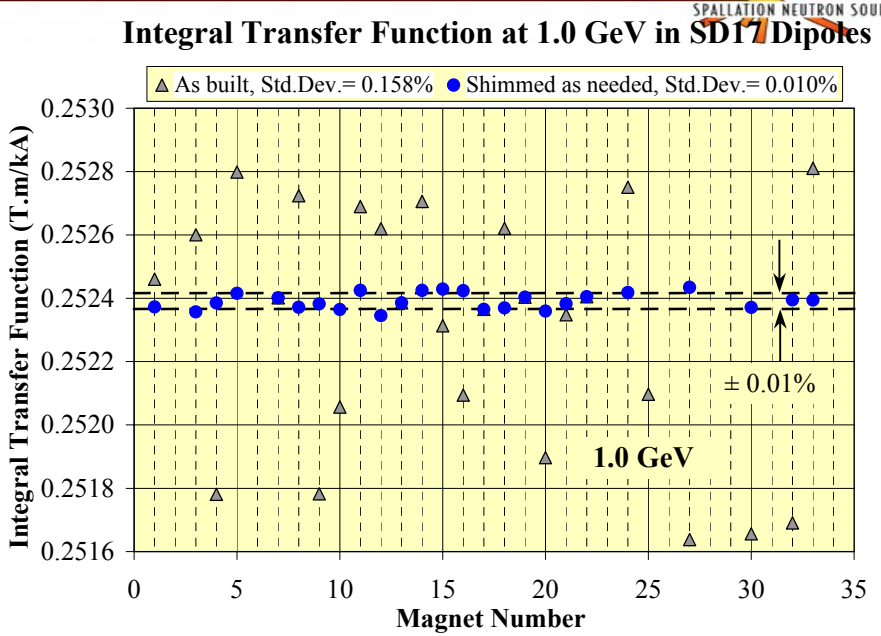
- Cryo line fabrication and installation is going very well.
- Compressors are in place.
- Cold Box has had several delays. Should be on site middle of October.

West Tunnel w/Warm Piping

Cold Compressors in the CHL

"T" Section

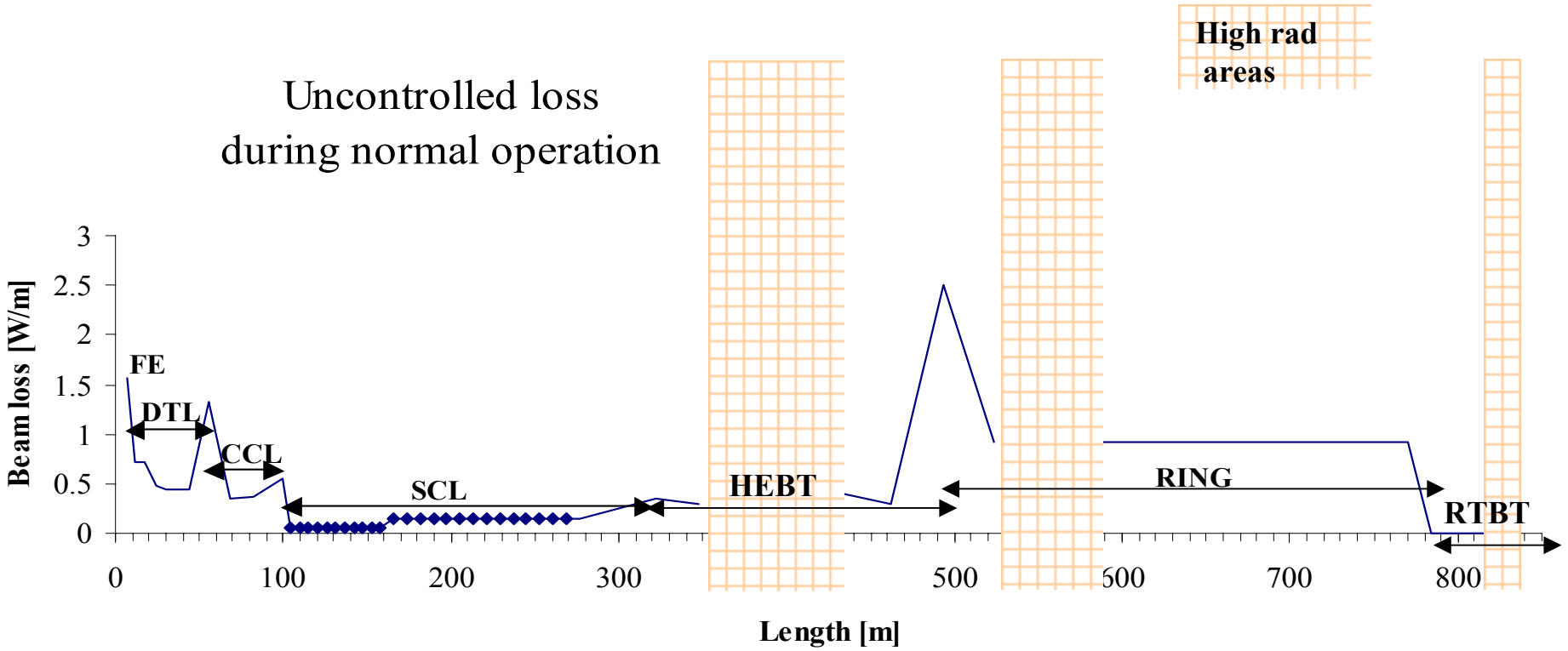
Ring and Transport Systems



- On schedule & within baseline, ring half-cell ready for final survey & tests
- Encouraged by ASAC, work intensively on magnet measurement & shimming
  - Dipole: reduce field variation at 1 GeV to 10^{-4}; sort according to 1.3 GeV
  - Quad: closely monitor measurement data; prepare for shimming, maybe ok
- Have done an excellent job…

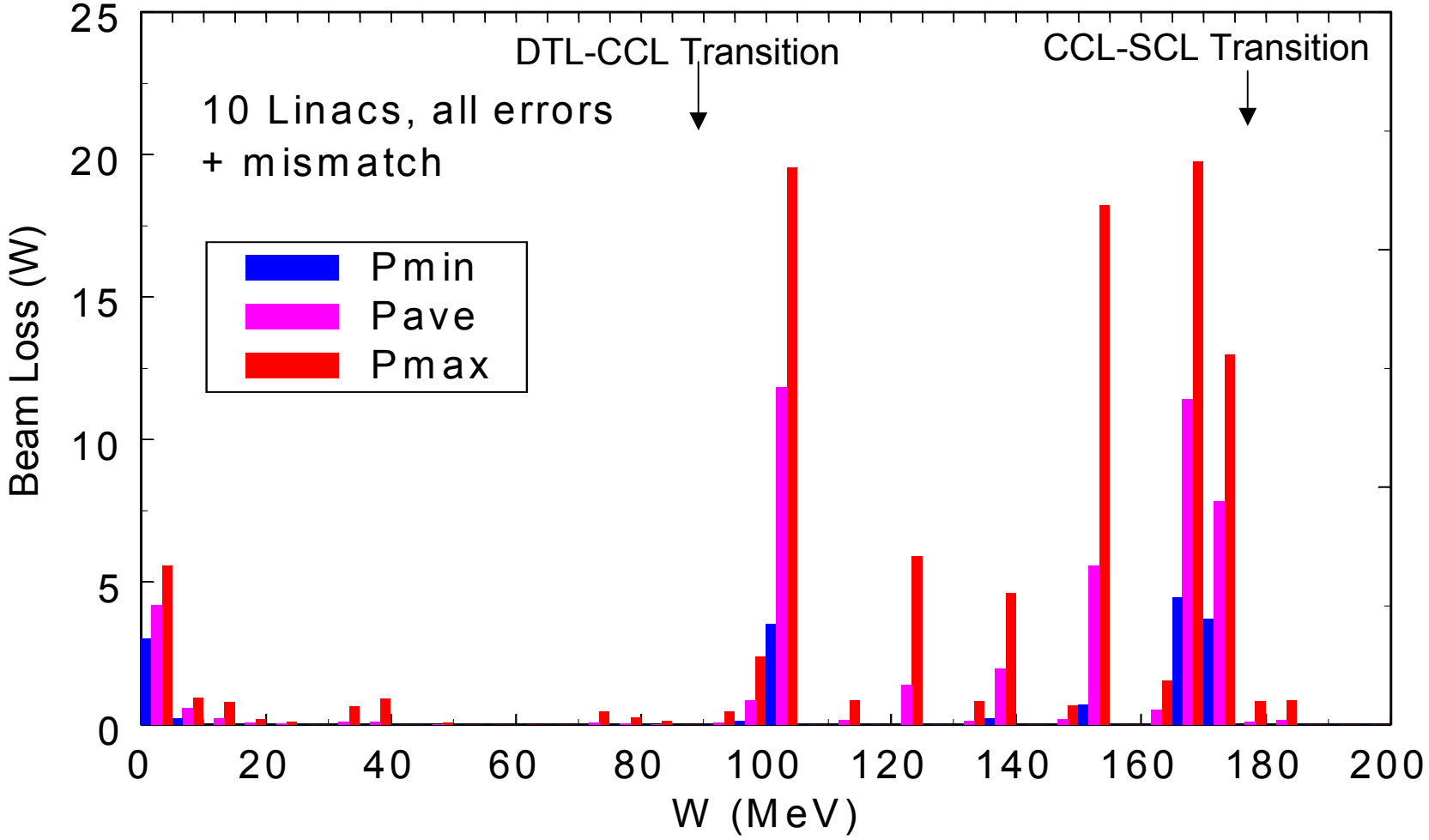
Primary Concern: *Uncontrolled Beam Loss*

- **Hands-on maintenance: no more than 100 mrem/hour residual activation (4 h cool down, 30 cm from surface)**
- **1 Watt/m uncontrolled beam loss for linac & ring**
- **Less than 10^{-6} fractional beam loss per tunnel meter at 1 GeV; 10^{-4} loss for ring**

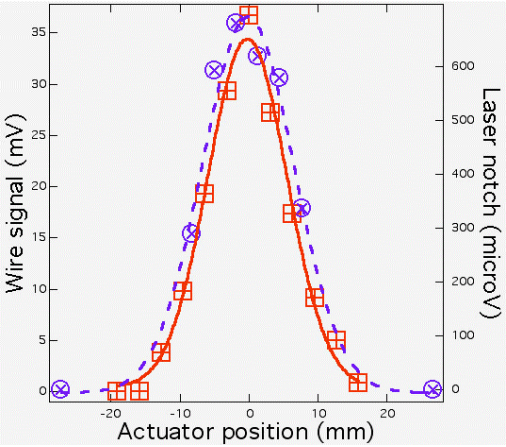


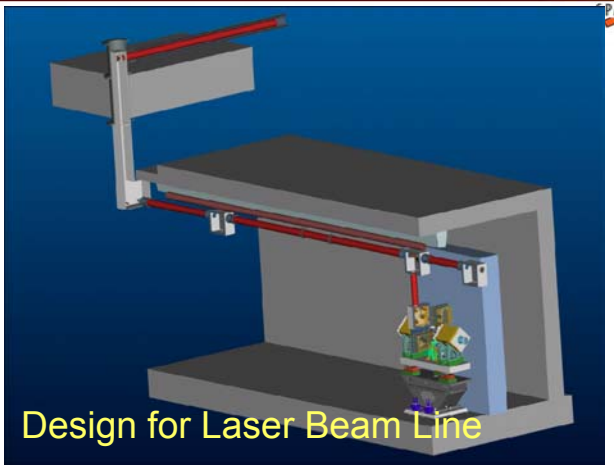
Beam Loss Occurs Primarily at Structure Interfaces for Mismatched Beams

Does not yet include MEBT scraping!

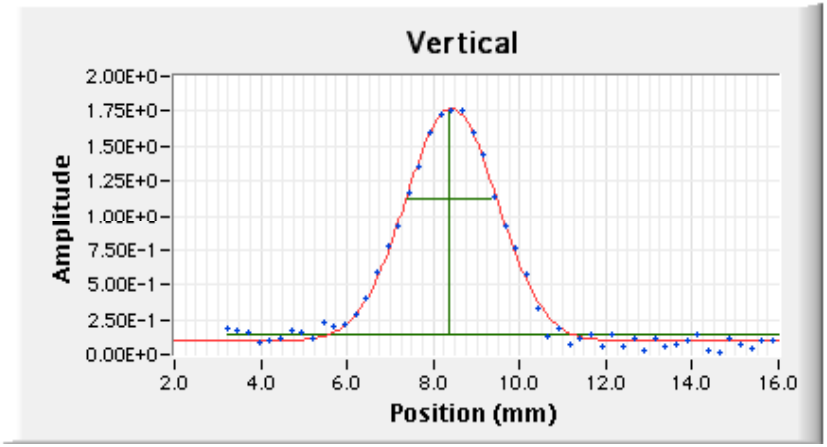


Concept, Design, Test and Implementation of SCL Laser-Wire System

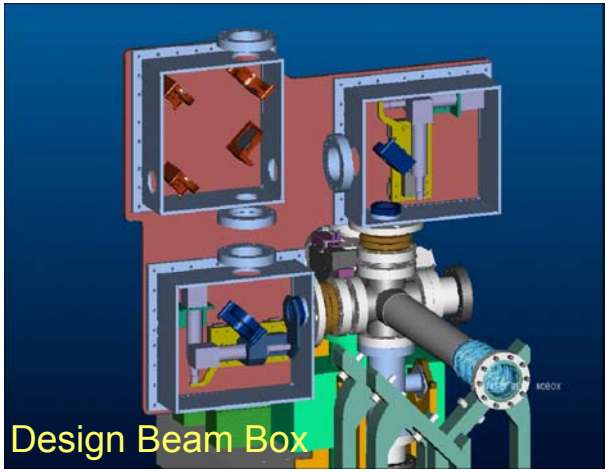




Carbon *vs* *Laser-Wire* at BNL 200 MeV Line



SNS-MEBT Vertical Profile



Collaborators: **BNL, FNAL, LBNL, LANL, ORNL, SLAC**

Summary

- SNS project is well on track to be the worlds highest pulses power neutron source.
- New records need new ideas and new tools: This is where diagnostics comes in in many ways
- Ultimately this facility will be limited by Beam Loss, almost nothing else.

- Have a nice workshop….